Reading: Chapters: 7.1-7.9, 9.1-9.6

Theory:
- Definition of a system of first-order linear ODEs, homogeneous and nonhomogeneous
- Matrix formulation of a system of first-order linear ODEs
- Definition of an eigenvector and eigenvalue of a matrix
- Linear independence of vector functions, Wronskian
- Principle of superposition for linear ODE systems (Theorem 7.4.1)
- Representation of solutions of linear ODE systems (Theorem 7.4.2)
- Classification of 2D linear ODE systems with constant coefficients (saddle, stable node/spiral, unstable node/spiral, center)
- Definition and properties of a fundamental matrix
- Definition and properties of a matrix exponential
- Linearization of nonlinear first-order systems of ODEs
- Definition of stability and asymptotic stability
- Definition of a Lyapunov function

Methods
- Converting n-th order ODE in a single variable to a system of first-order linear ODEs
- Finding eigenvectors and eigenvalues of a matrix
- Solving homogeneous linear ODE systems with constant coefficients (distinct real eigenvalues, repeated real eigenvalues, complex eigenvalues)
- Characterizing the behavior of solutions
- Computing fundamental matrices Ψ(t) and Φ(t)
- Computing matrix exponential for diagonalizable, nondiagonalizable and nilpotent matrices
- Computing equilibrium points of nonlinear first-order systems of ODEs
- Computing Jacobian
- Classifying equilibria of nonlinear ODE systems
- Finding nullclines, determining direction of the flow across nullclines
- Finding invariant sets
- Determining stability of equilibria
- Analysis of competing species models
- Analysis of predator-prey models
- Verification of stability using Liapunov method

Allowed aids: You are allowed one sheet of integral formulas and algebraic relations.